Partial Translation of Japanese Laid Open Publication 2003-55747

[0006] The chemical component of the sintered tool steel according to claim 1 of the present invention may be similar to the conventional tool steel, i.e., carbon tool steel, alloy tool steel, high speed tool steel, etc. However, it is more preferable that the sintered tool steel has the alloy component containing, by weight, 0.8 – 2.5% C, 3 – 8% Cr, 1 – 10% Mo, 1 – 20% W, 1 – 7% V, ≤ 15% Co, ≤ 1% Si, and ≤ 1% Mn, while W equivalent (2Mo + W) is simultaneously 15 – 30%, and the remaining is Fe and inevitable impurities (claim 2).

[0009] Both Mo and W are comprised of carbide and provide abrasion resistance. During quench hardening, they increase strength and hardness by partially providing a solid solution on the base, while being effective elements that improve heat resistance. It is necessary that greater than or equal to 1% of both the Mo and W are contained and that W equivalent (2Mo + W) is simultaneously greater than or equal to 15%. When Mo and W are greater than 10% and 20% respectively, and W equivalent (2Mo + W) is greater than 30%, the amount of carbide becomes large, thereby significantly decreasing the toughness. Therefore, the upper limit was set as the above.

[0013] This high-strength, ultra-fine grain sintered tool steel is obtained as follows. In particular, according to claim 4 of the present invention, the alloy that has, by weight, 0.8 – 2.5% C, 3 – 8% Cr, 1 – 10% Mo, 1 – 20% W, 1 – 7% V, ≤ 15% Co, ≤ 1% Si, and ≤ 1% Mn, while W equivalent (2Mo + W) being simultaneously 15 – 30%, and the remaining being Fe and inevitable impurities, is dissolved by a high-frequency smelting furnace. At the same time, liquid quenching powder is obtained through a gas-atomization or water-atomization process. Thereafter, the quenching powder is classified to be smaller than or equal to 75μm (grain size), reinforced through a ball mill or the like to manufacture high-deformation milling powder. Then, the milling powder is filled into a steel container for a vacuum degassing process at 400 – 600C° and heated at 800 – 1000C°. At the same time, rolling under a rolling reduction rate of 70 – 90% or extrusion under an extrusion ratio of 4 – 10 is performed to form and sinter the sintered tool steel. By providing the above-described manufacturing method, it was possible to obtain sintered tool steel having the carbide maximum grain size in alloy of ≤ 0.6μm and the average grain size of austenitic crystals of ≤ 2.0μm.

[0028] The composition of the alloy component contains, by weight, 0.8 – 2.5% C, 3 – 8% Cr, 1 – 10% Mo, 1 – 20% W, 1 – 7% V, ≤ 15% Co, ≤ 1% Si, and ≤ 1% Mn, while W equivalent

(2Mo + W) is simultaneously 15 – 30%, and the remaining is Fe and inevitable impurities. The carbide was refined while performance as tool steel was ensured. At the same time, by utilizing a pinning effect of the oxide that inhibits the growth of crystal grain, the super fine grain configuration was easily obtained.

[0029] By combining with the conventional methods, such as high-frequency smelting, gas-atomization/water-atomization, ball milling, vacuum degassing, and heated rolling/extrusion, the manufacturing method of the high-strength, ultra-fine grain sintered toll steel is easily provided by the present invention, which proved to be industrially beneficial.